pH-RESPONSIVE POLY(ACRYLIC ACID)-g-POLY(BOC-L-LYSINE) SELF-ASSEMBLING SHEAR-INDUCED INJECTABLE HYDROGELS

M-E. Karga[a], H. Iatrou[b], C. Tsitsilianis[a*]

[a] *Department of Chemical Engineering, University of Patras, 26500 Patras, Greece*

[b] *Department of Chemistry, University of Athens, Panepistimiopolis, Zografou, 15771 Athens, Greece*

[*]Correspondence: C.T. ct@chemeng.upatras.gr (tel.: +30-2610-969531)

ABSTRACT

In this study we report the rheological behavior of aqueous solutions of an amphiphilic graft copolymer constituted of polyacrylic acid, grafted by Poly(boc-L-lysine). Due to the hydrophobic nature of the grafted chains the copolymer self-assembles spontaneously in aqueous media forming a three-dimensional (3D) network. The rheological analysis demonstrated that the copolymer behaves as a strong elastic hydrogel in aqueous media, showing characteristics of a "frozen" network. Moreover, it is noteworthy that the formulation shows the above described characteristics in very small concentrations (~1% wt), compared to other natural occurred hydrogels that have been studied so far. Concentration significantly affects the rheological properties of the hydrogel, showing considerable increase of elastic modulus, following the scaling law $G' \sim C^{1.93}$. At the same time, the hydrogels can be described as intelligent-stimuli responsive systems, showing sensitivity to pH and response to shear and importantly is stable versus temperature. Thanks to the pH dependance of the degree of ionization of the polyelectrolyte backbone, due to the weak electrolyte nature of the pendant carboxyl groups of poly(acrylic acid), stiffness and swelling of the hydrogels can be tuned effectively by changing the pH conditions. Simulating conditions like those of injection through a 28-gauge syringe needle, the gel demonstrates excellent response to shear, showing shear thinning behavior. The viscosity drops two orders of magnitude upon applied shear stress and instantaneously returns to its initial values upon cessation of stress. It exhibits consequently excellent injectability thanks to its combined pH-sensitivity and shear responsiveness, forming additionally strong three-dimensional network when it enters the body at physiological conditions.

In conclusion, the hydrogels prepared from poly(acrylic acid) grafted by the biocompatibile and biodegradabile hydrophobic Poly(boc-L-lysine) exhibit remarkable features as tailor-made injectable hydrogel. Shear responsiveness, pH-sensitivity and concentration effect allow the design of the hydrogel properties that can response to their environment and be suitable for many biomedical potential applications such as controlled drug delivery, tissue engineering, wood healing etc.

KEYWORDS: Hydrogel. polyacrylic acid-*graft*-Poly(boc-L-lysine), Hydrophobic association, Shear-induced injectability, pH responsiveness.